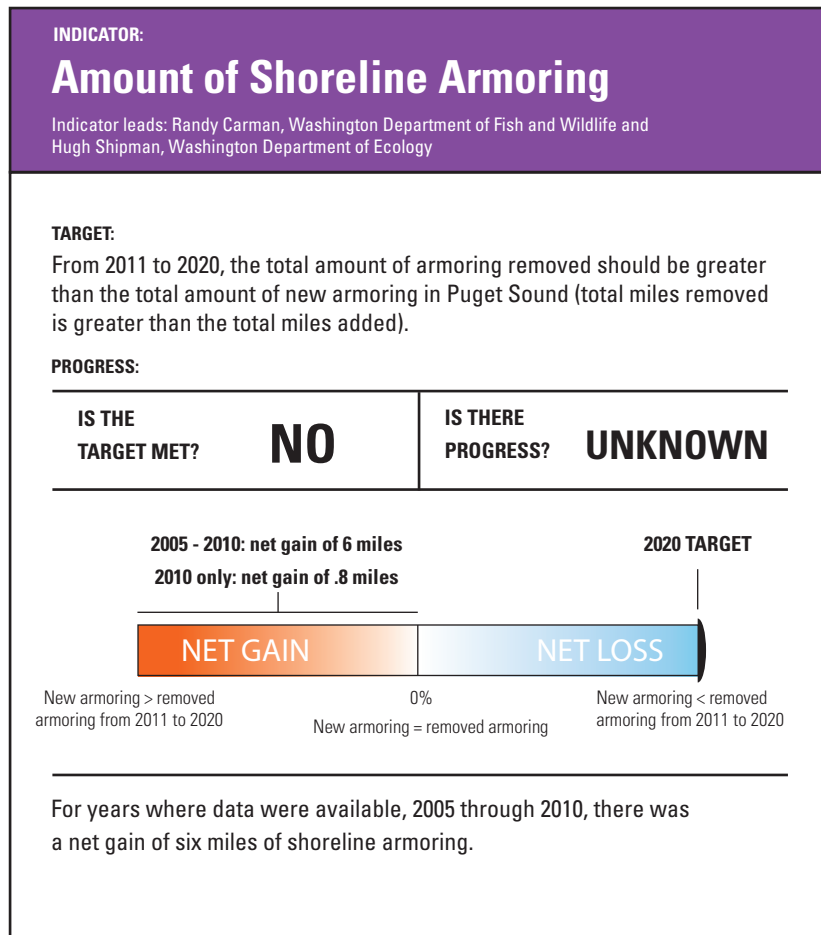


Shoreline Armoring

Puget Sound's 2,500 miles of shoreline are among the most valuable and fragile of our natural resources. A dynamic area where land and marine ecosystems meet, the shoreline is constantly changing with the action of wind, waves, tides, and erosion. These same shaping forces are also the reason why people often build bulkheads or other structures to harden the shoreline. Indeed, more than 25% of the shoreline has been armored to protect public and private property, ports and marinas, roads and railways, and other uses.

Shoreline armoring, the practice of constructing bulkheads (also known as seawalls) and rock revetments, disrupts the natural process of erosion, which supplies much of the sand and gravel that forms and maintains our beaches. Erosion also creates habitat for herring, surf smelt, salmon, and many other species in Puget Sound. Over time, shoreline armoring may cause once sandy beaches to become rocky and sediment starved, making them inhospitable to many of our native species.

Shoreline Armoring



Progress Towards 2020 Target

The analysis of current progress is pending due to ongoing compilation and analysis of 2011 data. However, we can use data from 2005 through 2010 to report on status and trends of shoreline armoring and make some predictions about progress toward reaching the target by 2020.

The amount of new shoreline armoring in Puget Sound was substantially greater than the amount removed for every year from 2005 through 2010 (Figure 1). Cumulatively, a net amount (new armoring minus removed armoring) of six miles of new armoring was constructed during this time frame, or on average, one mile of additional armoring per year. This pattern of net gain in armoring is the opposite of what is needed to meet the 2020 target.

However, the net amount of armoring per year declined by roughly 50% over these six years. This result is driven by the fact that more and more armoring has been removed annually since 2005, while additions have remained fairly constant. A notable exception occurred during 2006 and 2007, when new construction was highest, perhaps due to significant storms and shoreline damage that occurred early in the period. Despite this, the general trend of new versus removed armor has shown some movement towards the target. Even so, the fact remains that new armoring in Puget Sound was four to 400 times greater than removals from 2005 through 2010, overwhelming the small advance in removing armoring.

Although more armoring was removed each year between 2005 and 2010, it will take significant progress on both a) decreasing the amount of new armoring and b) increasing the amount of removed armoring to meet the target by 2020. If the recent pace of adding and removing armoring continues, an additional 10 miles of new armoring will be added to Puget Sound shorelines between 2010 and 2020, making it unlikely that the 2020 target will be met.

What Is This Indicator?

Although shoreline armoring is one of the indicators that measures the pressures on Puget Sound, rather than a measure of the state of the ecosystem such as the biomass of Pacific herring, it is an important indicator of ecological conditions in Puget Sound.

Shoreline armoring is the most common type of shoreline modification on Puget Sound. Armoring directly alters geologic processes that build and maintain beaches and spits. Bulkheads also impact erosion patterns on nearby beaches, alter beach substrate and hydrology, and reduce the availability of large wood.

These physical changes to beaches can diminish the availability and condition of key shoreline habitats. Armoring can also directly impact organisms and ecological processes by burying or displacing upper beach habitat and altering the natural transition between terrestrial and aquatic ecosystems. Impacts of armoring differ from one coastal setting to another, but have been demonstrated both on Puget Sound and elsewhere to impact habitat for fish, birds, and invertebrates.

Because of these adverse impacts on coastal processes and shoreline habitat, the goal is to decrease the amount of new armoring that occurs on Puget Sound, while also seeking opportunities to reduce armoring where feasible.

As new armoring is being constructed, concurrent efforts are deployed to remove armoring primarily for habitat

restoration. Thus, it is the difference between new and removed armoring that is of interest to address the target specifically, reported here as the net amount of shoreline armoring. To reach the target, there has to be a net loss of armoring cumulatively over 2011 to 2020.

Alterations to the shoreline are regulated primarily by two state laws, the Shoreline Management Act and the Hydraulic Code. Under the Hydraulic

**Puget Sound Shoreline Armoring Summary
2005–2010**

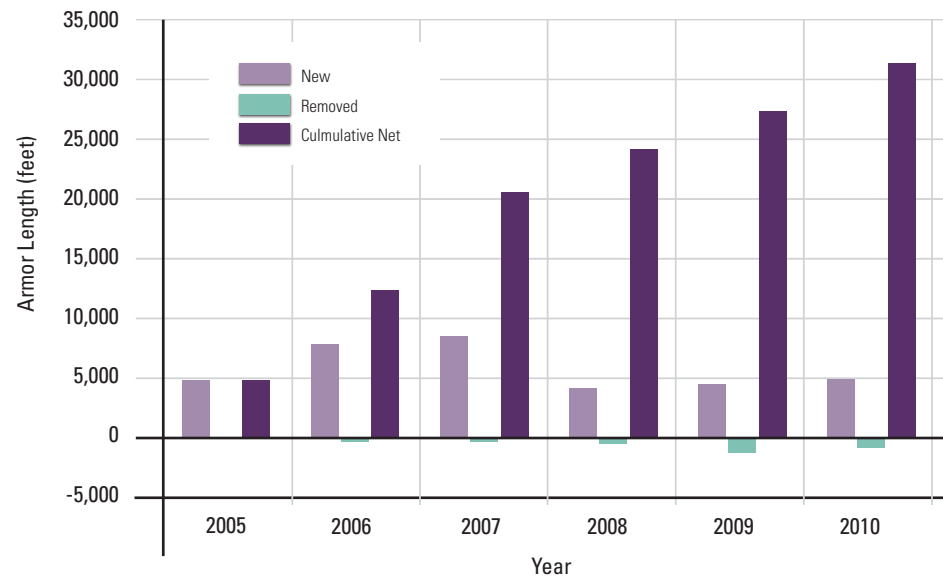


Figure 1. Amount of new armoring and removed armoring reported annually from 2005 to 2010 in Puget Sound, and the net amount of armoring accumulated since 2005. Data were compiled from the Hydraulic Project Approvals permits issued by the Washington Department of Fish and Wildlife.

Source: Washington Department of Fish and Wildlife, Habitat Program.

Shoreline Armoring

Code, project proponents seeking a permit for in-water and shoreline construction activities declare the amount of armoring they plan on adding, replacing, or removing in their application. Thus, data reported here were compiled from HPAs (Hydraulic Project Approval) issued from January 2005 through December 2010 by the Washington Department of Fish and Wildlife (WDFW). Projects were identified as: 1) new (previously unarmored shoreline), 2) replacement (complete replacement of existing armoring), and 3) removals (removal of existing armoring without replacement).

The Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) has been instrumental in compiling and reporting on changes to shorelines in Puget Sound over the past several decades. We relied on their data to report the length of shoreline and the overall amount of shoreline armoring in Puget Sound and by county.

Other Targets

Part of the 2020 target for shoreline armoring includes a focus on preventing new armoring and reducing existing armoring on feeder bluffs that supply sediments to Puget Sound shorelines. Activities are currently in progress to complete mapping of feeder bluffs in Puget Sound, including the condition of the



New Shoreline Armoring Distribution by County (2005-2010)

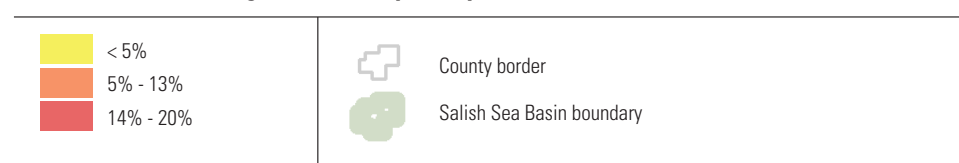


Figure 2. Amount of new armoring, county by county, as a percent of all new armoring in Puget Sound, cumulatively between 2005 and 2010. The numbers in the boxes are the percent of all new armoring and the amount of new armoring in feet for each county. Includes both hard and soft armoring
Source: Washington Department of Fish and Wildlife, Habitat Program.

bluffs. Until the feeder bluff mapping project is completed, it will not be possible to report on the amount of new armoring added or removed on feeder bluffs.

Similar language in the 2020 target refers to the use of soft shore techniques for new and replacement armoring where feasible. Reporting on this metric is currently constrained by the lack of adequate agreement on what constitutes a true soft shore project. Progress is being made to address this issue as part of a design guidance document currently being developed by WDFW and a consultant.

A total of 980 HPAs were issued for shoreline armoring projects in Puget Sound from January 2005 through December 2010. In all years, the amount of new armoring exceeded the amount removed (Figure 1). Just in 2010, the last year for which data were available, there were approximately 4,869 feet (0.9 miles) of new armoring, six times more than the amount of armoring removed (Figure 1). Furthermore, the amount of armoring replaced greatly exceeded either new or removed armoring.

Cumulatively, a net total of six miles of armoring was added in Puget Sound from 2005-2010, or, on average, one mile of additional armoring per year.

Interpretation of Data

Status and trends of Puget Sound wide armoring

Based on a compilation of a variety of data sources by the PSNERP, 27% of the shoreline of Puget Sound is armored (666 miles). Armoring is particularly extensive in highly developed residential, urban, or industrial centers. While most alterations to nearshore areas are heavily regulated, new and replacement shoreline armoring is still relatively commonplace for single-family residences, which accounted for more than three-quarters of the HPA permit applicants wishing to construct new armoring between 2005 and 2010 (Figure 3).

New shoreline armoring by applicant type

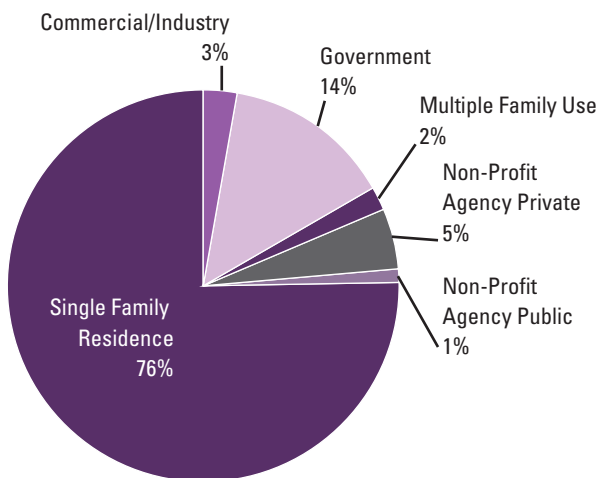


Figure 3. Percent of new armoring, by applicant type for years 2005-2010.

Source: Washington Department of Fish and Wildlife, Habitat Program.

Armoring removal by applicant group

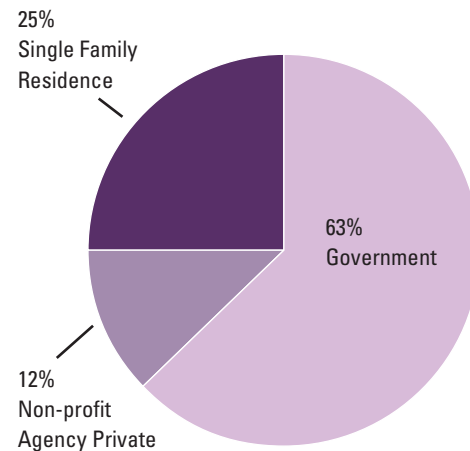


Figure 4. Percent of removed armoring, by applicant group for years 2005-2010.

Source: Washington Department of Fish and Wildlife, Habitat Program.

Shoreline Armoring

Overall, all project applications resulted in 6.5 miles of new shoreline armor, 0.61 miles of armor removal, and 14.45 miles of replacement armor.

There were no statistically significant linear trends in the amount of new or replacement armoring constructed through the six-year period. However, the amount of removed armoring significantly and steadily increased over the study period, albeit at a very small fraction of new armoring.

Increases in removals coupled with a reduced amount of new armoring for the second half of this period meant that the net amount of armoring declined between 2005 and 2010. During the first three years, the total net increase in armoring was 20,397 feet, compared to a total of 10,736 feet during the last three years. This is a 47% decrease in net new armoring constructed between the first and second half of the six-year period.

Armoring by counties

The total amount of shoreline armoring varies considerably across the 12 counties that border Puget Sound. Three counties account for nearly 50% of all the armoring in Puget Sound: King (13%), Pierce (18%), and Kitsap (16%) counties. These counties all have a high percentage of their shorelines armored: King 73%, Pierce 51%, and Kitsap 43%.

However, the HPA data revealed that most of the new armoring constructed between 2005–2010 was concentrated in somewhat different areas (Figure 2). Mason, Kitsap, and Island counties had the highest percentage of the new armoring, comprising a total of 51%. Pierce, San Juan and Skagit counties also accounted for a substantial amount of the new armoring with

a combined total of 34%. Therefore, six of the 12 counties in Puget Sound accounted for 85% of the new armoring from 2005 through 2010.

The same dataset indicates that armoring was removed in seven counties from 2005–2010. More armoring was removed in Kitsap County, totaling 1,873 feet (0.4 miles), than in any other county. A combined total of 1,353 feet (0.3 miles) was removed among the other six counties that included King, Pierce, Mason, San Juan, Island, and Jefferson. The remaining five counties in Puget Sound did not conduct any armor removal projects during the same time period.

The type of applicant that conducts new or armor removal projects was also compiled from the HPA data for years 2005–2010. Not surprisingly, most new armoring in Puget Sound (76%) was constructed on single family residence properties (Figure 3). In contrast, armor removal projects were primarily conducted on government properties (63%), whereas only 25% of the removals were on single family residential properties (Figure 4).

Powel Family Breaks Ground with Public-Private Partnership

Restoring Marine Nearshore Habitat

After nearly four years of restoration planning and design work, the Powel family and the Bainbridge Island Land Trust (BILT) broke ground on the Powel Shoreline Restoration Project at Port Madison in August 2012. This unique public-private partnership will restore more than 1,500 feet of natural shorelines on private property.

A showcase for other private shoreline landowners, the Powel Shoreline Restoration Project also increases awareness of the importance of and options for restoring nearshore habitats in Puget Sound on private land. The Powel family has been voluntarily working with BLIT, a local non-profit conservation organization, on restoration options and have donated a perpetual conservation easement now held by BLIT.

"I've sailed around Puget Sound and have seen the beauty and benefits of undeveloped, naturally functioning shorelines," said landowner Jake Powel. "We are excited for the opportunity to remove bulkheads, restore habitat, and improve beach access."

The Powel family has lived on Bainbridge Island for nearly 60 years. About 1,800 lineal feet of their property's shoreline had been hardened with bulkheads made of concrete, creosote logs, and other materials. The project will remove most of the bulkheads and increase important habitats on the property, including increasing intertidal habitat area by

About 1,800 lineal feet of their property's shoreline had been hardened with bulkheads made of concrete, creosote logs, and other materials

Aerial photo of the Powel Family property before the restoration efforts began.



Powel Family Breaks Ground with Public-Private Partnership

163%, enhancing more than 32,000 square feet of marine riparian habitat, and almost tripling the amount of salt marsh habitat over time. The project focuses on restoring shallow intertidal habitat important to juvenile salmonids, particularly endangered Chinook, for migration, feeding, and refuge.

Funding for the project has been provided by the Powell family, BILT, and the State of Washington's Puget Sound Acquisition and Restoration (PSAR) fund, which is administered by the Salmon Recovery Funding Board and appropriated by the Legislature.



Representatives of the partners involved in the project: Tony Wright, Executive Director of the Puget Sound Partnership, Jim Brennan, Washington Sea Grant, Asha Rehnberg, BILT Executive Director, Ann Powell and Jake Powell (landowners)